High Performance Ventilation Equipment

PRO-C Series
Energy Recovery Ventilator

For Carrier® HJ, TM and TF Rooftops
(Sizes 3 to 12.5 ton)

Technical Guide

PRO-C-1000
PRO-C-2400

ERV® SYSTEMS

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The PRO-C Series

The PRO-C Series Energy Recovery Ventilator is an outdoor air preconditioner specifically designed to reduce the energy required to cool or heat the outdoor air by as much as 80 percent. The PRO-C also allows the Carrier® 3 through 12.5 ton HJ, TM, and TF rooftop air-conditioner systems to effectively and economically accommodate the three-to-four fold increase in outdoor air quantities, which is recommended by the ASHRAE Standard 62, *Ventilation for Acceptable Indoor Air Quality*. This unique capability allows both new and existing buildings to benefit from healthy indoor environments.

The PRO-C is designed to improve humidity control when combined with the Carrier rooftop equipment. Because the unit preconditions the incoming air to the packaged equipment, the required refrigeration capacity can be reduced by as much as 50 percent. Thus, the costs of the PRO-C and its installation are typically offset by the reduced size of the Carrier system. Generally, any first cost premium is paid back within the first year of operation.

Preconditioning and Good IAQ

ASHRAE Standard 62 defines the minimum outdoor air ventilation rate required to achieve acceptable indoor air quality. This standard, which is incorporated in all the U.S. model building codes (BOCA, Southern, and Uniform), recommends that outdoor air quantities be increased from 5 cfm per person to 15 to 20 cfm per person to avoid adverse health effects. The increased ventilation air rates concern many owners, architects, and engineers with regard to their impact on humidity control, operating costs and construction costs.

By recovering up to 80 percent of the total energy normally exhausted from facilities, the PRO-C provides an effective solution to the ventilation mandate. When a PRO-C is combined with a Carrier rooftop unit, it allows for a three-to-four-fold increase in the outdoor air quantity (5 to 20 cfm/person) without an increase in operating costs.

If a facility is designed to include unitary packaged HVAC equipment or heat pumps, the addition of a PRO-C is especially beneficial. In addition to reducing the cost of operation, the PRO-C system greatly improves humidity control; something that is important for providing acceptable indoor air quality.

Humidity Control and IAQ

Unitary air conditioner and heat pump units are controlled by temperature. When space conditions are satisfied, the cooling coil or heating source is cycled off. Since the ASHRAE Standard 62 recommends the continuous supply of outdoor air, then warm/humid (cooling mode) or cool/dry (heating mode) outdoor air is dumped directly into the occupied space during those times.

As the outdoor air load changes, humidity levels can fluctuate significantly with unitary HVAC equipment and heat pumps. To achieve an acceptable indoor environment, space humidity conditions should be maintained between 30 and 60 percent relative humidity. The probability of microbial problems, i.e., mold growth, is greatly enhanced at 70 percent relative humidity and above.

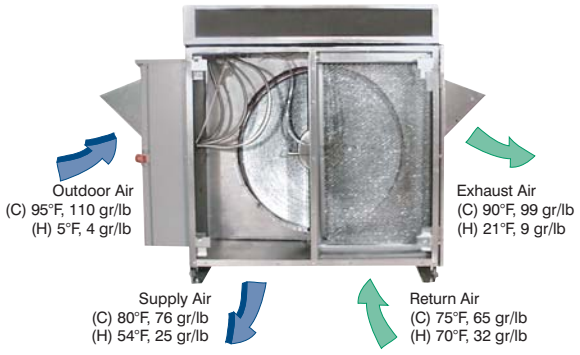
How It Works

The PRO-C Series is a packaged system, which includes supply and exhaust air fans, outdoor and return air filter and a TEC total energy recovery wheel. The TEC wheel recovers both sensible (temperature) and latent (moisture) energy; it cools and dehumidifies the outdoor air during the cooling season, while heating and humidifying the outdoor air in the heating season.

The TEC wheel utilizes a fluted aluminum substrate, which is uniformly coated with a fast-acting, adsorbent desiccant. As the transfer media slowly rotates between the outdoor and exhaust airstreams, the higher temperature air gives up its sensible energy to the aluminum. This energy is then given up to the cooler airstream during the second half of the revolution. (See Figure 1.)

Just as the temperature is captured and released, so is the moisture. TEC's desiccant coating has an enormous internal surface area and a strong attraction for water vapor. Since the opposing airstreams have different temperature and moisture contents, their vapor pressures differ. This difference causes the transfer of latent energy.

Figure 1. An inside view of the PRO-C ventilator with typical operating conditions during the cooling (C) and heating (H) season respectively.



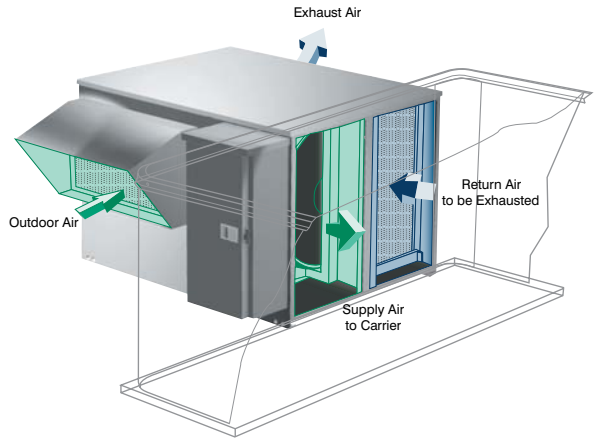
Applying the PRO-C Series Unit

The PRO-C Series has supply and return connections located on the side of the unit and is designed to mate up to the selected Carrier rooftop air-conditioner. The PRO-C is designed for outdoor installation, has a high level of total recovery effectiveness and includes a single-point electrical connection.

In a typical application, the PRO-C pulls exhaust air directly from the return air section of the Carrier unit. Preconditioned outdoor air is then provided directly to the cooling coil, mixing with the recirculated airstream. The PRO-C unit and Carrier's supply fans run continuously while occupants are in the conditioned space, even when the heating or cooling coils are off. This provides a continuous supply of outdoor air, therefore meeting the ASHRAE Standard 62 guidelines.

A key advantage to this approach is that no additional ductwork is required beyond that which is already provided for the Carrier unit. This simplifies the installation process and minimizes project first cost. This approach also simplifies retrofit applications where it is desirable to increase the amount of outdoor air supplied to a space without replacing the existing HVAC system.

Figure 2. PRO-C Series typical installation.



Benefits

Reduced Equipment First Cost

Without the addition of effective energy recovery, the capacity of HVAC systems must be increased greatly to handle the greater outdoor air loads. Increasing equipment size often requires the addition of reheat and sophisticated control sequences to control both humidity and temperature. The PRO-C often reduces project first cost by allowing a smaller Carrier unit and duct system to be used, without the need for reheat or complex controls.

Economical Compliance with ASHRAE Standard 62

To achieve acceptable indoor air quality, ASHRAE Standard 62 recommends a three-to-four-fold increase in the amount of outdoor air provided to most facilities. In addition, the ASHRAE Standard recommends that this increased outdoor air quantity be introduced continuously while spaces are occupied. By recovering up to 80 percent of the total energy normally exhausted from occupied spaces, the PRO-C enables the Carrier unit to effectively handle this increase in outdoor air load without the need for a larger sized package and without increasing energy consumption.

Improved Cooling Season Humidity Control

Operation of conventional HVAC systems is governed by a thermostat, i.e., in response only to the conditioned space temperature. When the cooling coil is cycled off, the outside air fan is typically shut-off as well. Thus, no ventilation is provided to the conditioned space until the thermostat calls for cooling. If the outside air fan is allowed to run while the cooling coil is off, then warm, humid air is directed to the space. In both of these cases, indoor space humidity levels will increase above guideline levels, i.e., 60 percent relative humidity.

Since the PRO-C unit dehumidifies and cools the incoming outdoor air, the supply air conditions are close to the return air conditions. This effectively produces a buffer against high outdoor latent loads resulting in acceptable indoor humidity levels.

Helps Reduce Humidification Requirements During the Heating Season

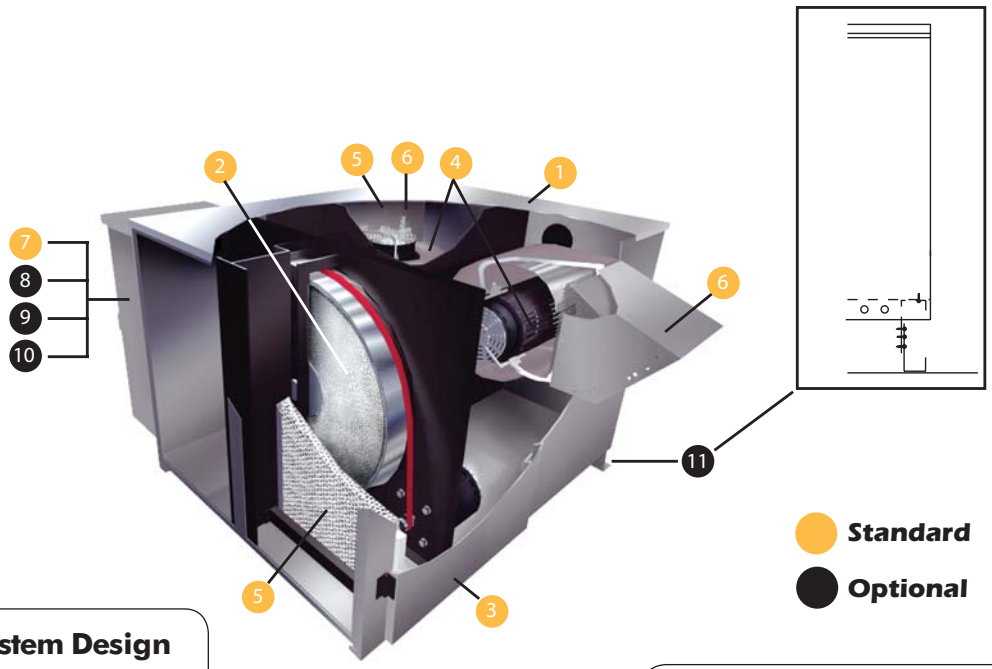
Supplying 15 to 20 cfm/person of cold, dry outdoor air to a facility during the heating season can result in unacceptably low indoor relative humidity. Most facilities require humidification, which is costly to operate and maintain. The PRO-C unit captures the moisture generated within the space to provide free humidification during the heating season, therefore maintaining a healthier indoor environment.

In moderate climates with short heating seasons, this may be sufficient to completely eliminate the need for any humidification equipment.

Improves the Comfort of Occupied Spaces

As outdoor air is supplied to the space, the heating/cooling source is cycled on and off to maintain temperature. When it is cycled off, very cold or very warm/humid air can be "dumped" on the occupants, causing wide temperature fluctuations, which makes for a very uncomfortable environment. The PRO-C solves this problem by providing moderated supply air conditions, even as the Carrier unit is cycled on and off.

Features



1 Novel System Design

• Efficient and economical design meeting the needs of the conventional HVAC market.
• Compact, low profile design to conform to typical architectural requirements.
• Easy access to all internal components through a large hinged access door and removable roof panel.
• Outdoor air inlet and exhaust air outlet located at opposite ends of unit.

2 TEC Wheel

• Certified total energy (both sensible and latent) recovery performance.
• Easily removable wheel cassette module.
• Surpasses NFPA-90A requirements having a smoke and flame spread rating of 0 and 0, vs. 50 and 25 allowed by the standard.
• Self-adjusting air seals.

3 Cabinet Construction

• Galvanized steel cabinet construction.
• Entire cabinet insulated to minimize energy loss.
• Hinged doors for easy access.
• Floor of the unit built as a pan to ensure watertight design.

4 Supply & Exhaust Fans

• Sized for quiet and efficient operation.
• Mounted and balanced.

5 Filter Sections

• Filtration provided for both the outdoor air and return air.

6 Hoods and Dampers

• Airflow balancing dampers.
• Unit provided with an intake hood with cleanable filter to limit rain and snow introduction.
• Exhaust air back draft damper.

7 Electric Package

• All motors wired to starters.
• Accepts contact inputs for supply fan start/stop, wheel start/stop and unit start/stop.

PRO-C-1000:	208, 240V 1Ø, 208, 240, 480V 3Ø
PRO-C-2400:	208, 240V 1Ø, 208, 240, 480V 3Ø

8 Electric Preheat

• An electric preheat coil can be provided to avoid frosting conditions for installations in cold climates, which have high indoor humidity design conditions.

9 Frost Protection

• Thermostatic frost control allows the entire PRO-C unit to be turned off at a predetermined temperature when electric preheat is not desired.

10 Control Options

• Stop/Jog Economizer board allows the wheel to be stopped automatically during mild outdoor temperatures with periodic brief rotation.
• Wheel Frost Protection allows the wheel only to be stopped by the stop/jog economizer board at a predetermined outdoor temperature
• Rotation Detector Sensor can provide an alarm signal through the stop/jog economizer board indicating failure of the wheel rotation.

11 Pedestal Support

• Optional support is adjustable from 9”-14”.

Selection Procedure

The selection of the PRO-C Series is governed by two parameters: the amount of outside air needed to be pre-conditioned and the Carrier unit to which the PRO-C is to be mated shown in Table 1. Only a specific size PRO-C will mate to a Carrier unit. Nominally, the PRO-C will provide between 30% and up to 100% of outside air. There is a limited product combination which will allow 100% outside air applications.

Table 1. ERV Systems/Carrier Unit Combinations.

	PRO-C-1000	PRO-C-2400
Carrier Weathermaster	48/50HJ004	48/50HJ008
	48/50HJ005	48/50HJ009
	48/50HJ006	48/50HJ012
	48/50HJ007	48/50HJ014
Carrier Weathermaker	48/50TM004	48/50TM008
	48/50TM005	48/50TM009
	48/50TM006	48/50TM012
	48/50TM007	48/50TM014
	48/50TF004	48/50TF008
	48/50TF005	48/50TF009
	48/50TF006	48/50TF012
	48/50TF007	48/50TF014

Notes:
Refer to Pro Series Models when attaching rooftop units larger than 12.5 tons (transition required) and when using as a stand-alone ventilator.

1. Determine Supply Side Recovery Efficiency

Enter Table 2 to determine the recovery wheel face area per airstream. Divide the smaller volume of the two airstreams by the wheel area obtained from Table 2 to determine face velocity. Enter Table 3 for the face velocity of the smaller airstream to determine the unit base effectiveness at equal airflows.

If the airflows are not equal, then divide the supply air volume by the return air volume to determine the airflow ratio. Using the base effectiveness determined from Table 3 and the calculated airflow ratio, enter Table 4 to obtain the corrected supply air efficiency for unequal airflow applications.

Example:
Given a supply airflow of 965 and exhaust airflow of 1015. From Table 2, the PRO-C wheel area per side is 1.23 sq. ft. Dividing 965 cfm (supply) by 1.23, gives a (supply side) face velocity of 785 ft/min. From Table 3 the base effectiveness is interpolated at 68 percent. Using the base effectiveness and an airflow ratio of 0.95 (965cfm/1015cfm) from Table 4 determines the supply side efficiency to be 70.6 percent.

Table 2. Airflow Range and Energy Wheel Area.

Model	Airflow Range (scfm)	Wheel Face Area (ft^2/side)
PRO-C-1000	450-1110	1.23
PRO-C-2400	800-2600	2.46

Table 3. Unit Effectiveness vs. Wheel Face Velocity.

Wheel Face Velocity (fpm)	Total Recovery Effectiveness (%)
300	80.3
400	77.8
500	75.3
600	72.8
700	70.3
800	67.8
900	65.3
1000	62.8
1100	60.3

Table 4. Unequal Airflow Efficiency Correction.

Ratio of SA Flow to RA Flow	Base Effectiveness						
	68	70	72	74	76	78	80
0.7	82.6	84.0	85.5	87.0	88.5	90.0	91.4
0.8	78.0	79.8	81.5	83.2	84.9	86.7	88.4
0.9	73.2	75.1	77.0	78.9	80.8	82.7	84.7
1.0	68.0	70.0	72.0	74.0	76.0	78.0	80.0
1.1	66.1	67.9	69.6	71.4	73.1	74.8	76.6
1.25	62.4	63.8	65.2	66.6	68.0	69.4	70.8
1.4	58.5	55.9	60.7	61.8	62.9	63.9	65.1

2. Calculate the Supply Air Conditions

Once the design conditions are known and the supply side efficiency is determined, the temperature and humidity content of the air supplied to the space can easily be calculated by using Equation 1. Using dry bulb temperatures in Equation 1 provides the supply air temperature. The supply air humidity level is also determined in Equation 1 by using grains of moisture or humidity content (lb. moisture/lb. dry air). The enthalpy of the supply air can be calculated in the same manner. Do not use equation 1 to calculate the wet bulb temperature.

Example continued:
Summer outdoor air design conditions are 90°F, 110 gr/lb with a return condition of 75°F, 50% relative humidity (65 gr/lb.)

Using Equation 1, the summer supply temperature and humidity is calculated as follows:

$$T_{SA} = (90°F - .706\ (90 - 75)°F) = 79.4°F$$

$$w_{SA} = (110\ gr/lb - .706\ (110 - 65)gr/lb) = 78\ gr/lb$$

Winter outdoor air design conditions are 5°F, 4 gr/lb with a return air condition of 70°F, 32 gr/lb.

The winter supply air temperature and humidity level is calculated in the same fashion to give a condition of 51°F and 24 gr/lb.

Equation 1. Calculating supply, outdoor, and return air temperatures and moisture contents.

$$X_{SA} = \{X_{OA} - (Efficiency_{SA})\ (X_{OA} - X_{RA})\}$$

where

X = dry bulb temperature in °F
-or- humidity content in gr/lb.
-or- enthalpy in Btu/lbs.

Indices

SA = supply air
OA = outside air
RA = return air

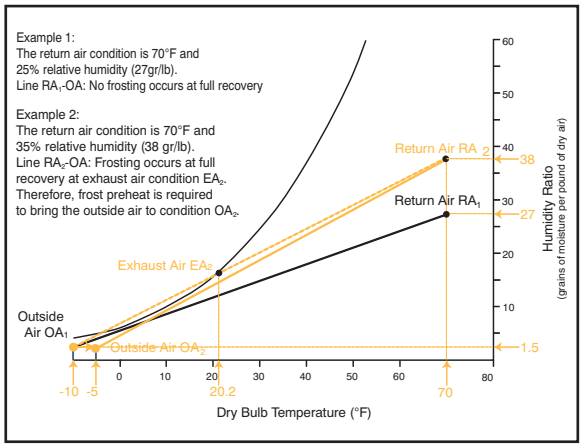
3. Determine if Frost Protection is Required

Plotted on a psychrometric chart, the performance of an enthalpy recovery wheel will form a straight line between the outdoor air and return air conditions. If this line does not pass through the saturated line on the psychrometric chart, or if the leaving exhaust air condition of the wheel is not below freezing, the wheel will not frost. In general, if the space is not humidified above 30 percent relative humidity on extreme winter days and the outdoor design is above 0°F, then frost protection is probably not required.

Should frost protection be required, three different methods of frost protection are available on the PRO-C units.

- Preheat is used as the primary method of frost protection for the energy wheel in PRO-C units. This employs an electric heater on the outdoor air intake to raise the incoming air temperature such that the operating line of the wheel no longer hits saturation. This is the preferred method since it requires usually only about 10°F of preheat to avoid frosting and the wheel continues to operate at full capacity even at the extreme conditions.
- The stop/jog economizer can be programmed to stop the wheel rotation below a preset outdoor air temperature. This has the disadvantage of introducing untreated, cold outdoor air to the Carrier unit.
- A frost protection thermostat which turns the PRO-C unit off below a preset outdoor air temperature is the third available option. This is generally considered the least attractive solution since it results in the unit supplying no outdoor air during low temperature periods.

Figure 3. Using the psychrometric chart to determine the need for preheat frost control.



4. Determine Dimensional & Electrical Data

The dimensional data for the PRO-C unit is provided on page 7. The PRO-C unit is mounted adjacent to the Carrier unit.

The electrical data is determined on page 13, equation 2 and 3. Since the electrical requirements are a function of the power source, the desired power source (voltage and phase) must be known before determining this information. If an electrical preheater is required, the electrical data should be increased appropriately by the information given in Table 5, page 14.

Example continued:
Assuming that 240V/1Ø power is available, the minimum circuit ampacity (MCA) for the motors selected in Step 2 is calculated using equation 2a on page 13.

*1.25 * FLA largest fan motor*	=	*8.6 (1.25*6.9)*
+ FLA other fan motor	=	*6.9*
+ FLA wheel drive/accessories	=	*1.1*
MCA	=	*16.6*

The maximum circuit overcurrent protection is calculated using Equation 3 on page 13.

*2.25 * FLA largest fan motor*	=	*15.53 (2.25*6.9)*
+ FLA other fan motor	=	*6.9*
+ FLA wheel drive/accessories	=	*1.1*
MOP	=	*23.53*

5. Summarize Selection Information

A selection summary sheet is provided on page 15 which helps organize the performance data when ordering an PRO-C unit and simplifies the design schedule preparation process.

Fan Tables

PRO-C-1000

		External Static Pressure (in.wg.)*				
Supply Fan Data		-0.3	-0.1	0.1	0.3	0.5
	Airflow (scfm)	1110	1035	965	885	805

		External Static Pressure (in.wg.)*				
Exhaust Fan Data		-0.3	-0.1	0.1	0.3	0.5
	Airflow (scfm)	1235	1235	1135	1015	890

All motors 1/2hp, 1,625 rpm

PRO-C-2400

	Airflow (scfm)	External Static Pressure (in.wg.)*				
		-0.3	-0.1	0.1	0.3	0.5
		Motor Brake Horsepower/RPM				
Supply Fan Data	800	.15/516	.15/651	.15/785	.15/919	.24/1025
	1000	.15/579	.15/734	.15/889	.24/1008	.43/1113
	1200	.15/670	.15/872	.26/1007	.46/1114	.64/1219
	1400	.15/881	.31/1024	.50/1132	.70/1233	.86/1307
	1600	.38/1058	.58/1168	.78/1259	.95/1337	1.09/1415
	1800	.68/1218	.89/1302	1.07/1385	1.22/1468	1.40/1536
	2000	1.03/1366	1.21/1456	1.39/1526	1.65/1591	1.85/1656
	2200	1.41/1529	1.69/1590	1.92/1653	2.11/1715	2.32/1777
	2400	2.01/1657	2.20/1716	2.40/1774	2.60/1833	2.79/1891
	2600	2.50/1778	2.70/1838	2.87/1898	N/A	N/A

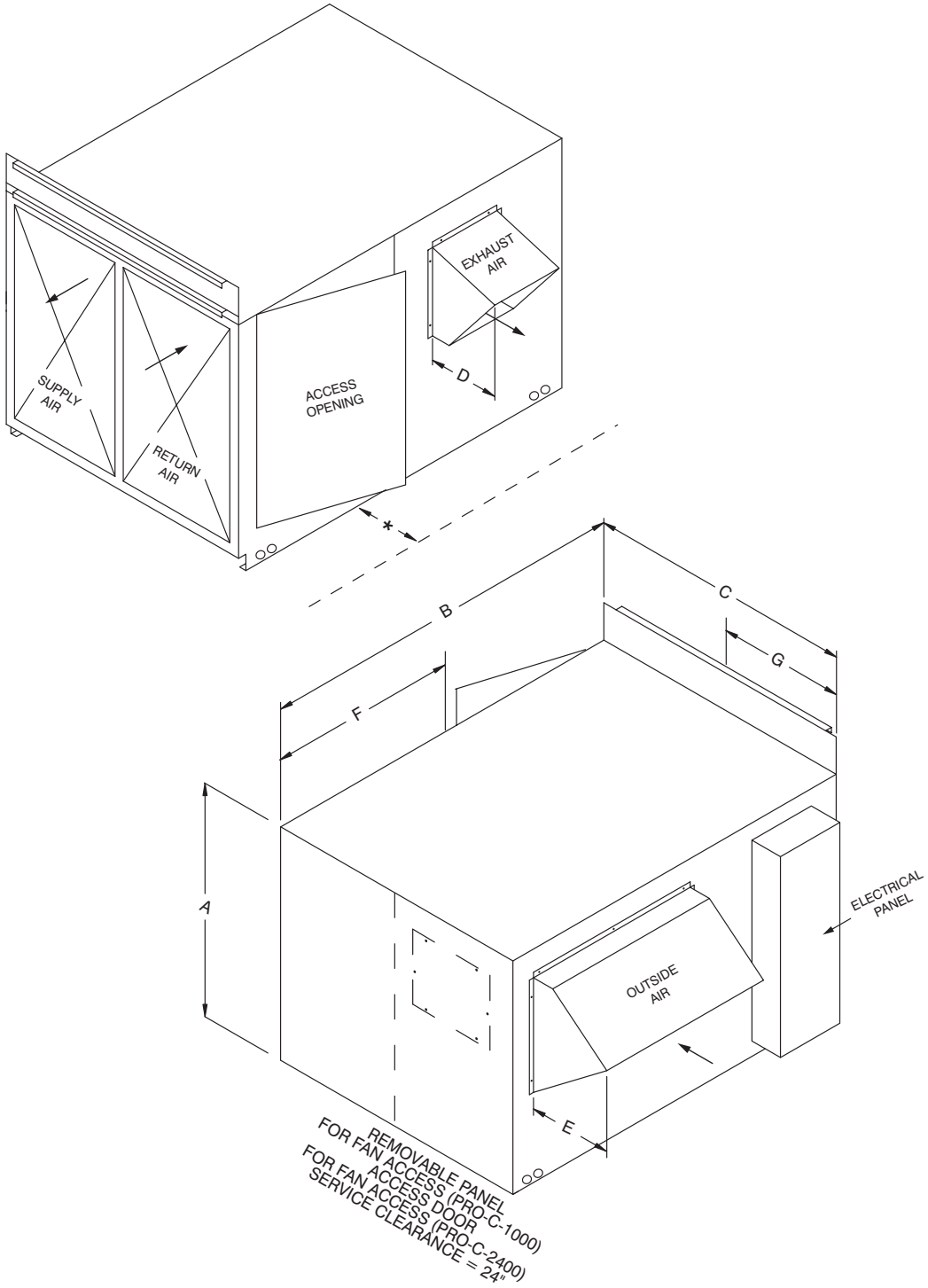
	Airflow (scfm)	External Static Pressure (in.wg.)*				
		-0.3	-0.1	0.1	0.3	0.5
		Motor Brake Horsepower/RPM				
Exhaust Fan Data	800	.15/497	.15/667	.15/836	.15/979	.15/1089
	1000	.15/575	.15/751	.15/925	.15/1036	.15/1145
	1200	.15/659	.15/845	.15/989	.15/1098	.33/1207
	1400	.15/758	.15/946	.15/1056	.29/1165	.69/1261
	1600	.15/887	.15/1019	.24/1129	.67/1235	1.00/1320
	1800	.15/987	.19/1098	.64/1208	1.03/1302	1.30/1393
	2000	.15/1071	.61/1184	1.06/1287	1.36/1386	1.62/1482
	2200	.60/1164	1.07/1276	1.41/1386	1.70/1489	1.98/1577
	2400	1.07/1269	1.46/1395	1.79/1502	2.11/1590	2.42/1678
	2600	1.52/1417	1.89/1520	2.24/1605	2.57/1686	2.88/1734

Supplied Motor:	0.75 hp, 1725 rpm	1.50 hp, 1725 rpm	2.00 hp, 1725 rpm	3.00 hp, 1725 rpm

Note: For power draw of motors, see Table 5 page 14. When sizing fan motors, it is not required to add purge air or seal leakage as these corrections are reflected in the fan charts.

* Positive statics reference external static pressures that work against the PRO-C unit fan. Negative statics would work with the PRO-C unit fan. For example, an PRO-C mounted to a Carrier unit with a -0.3" static pressure in the Carrier mixing section would have an PRO-C supply fan static of -0.3" and an exhaust fan static of +0.3". All statics internal to the PRO-C module are already included in the selection.

Unit Arrangement & Dimensions

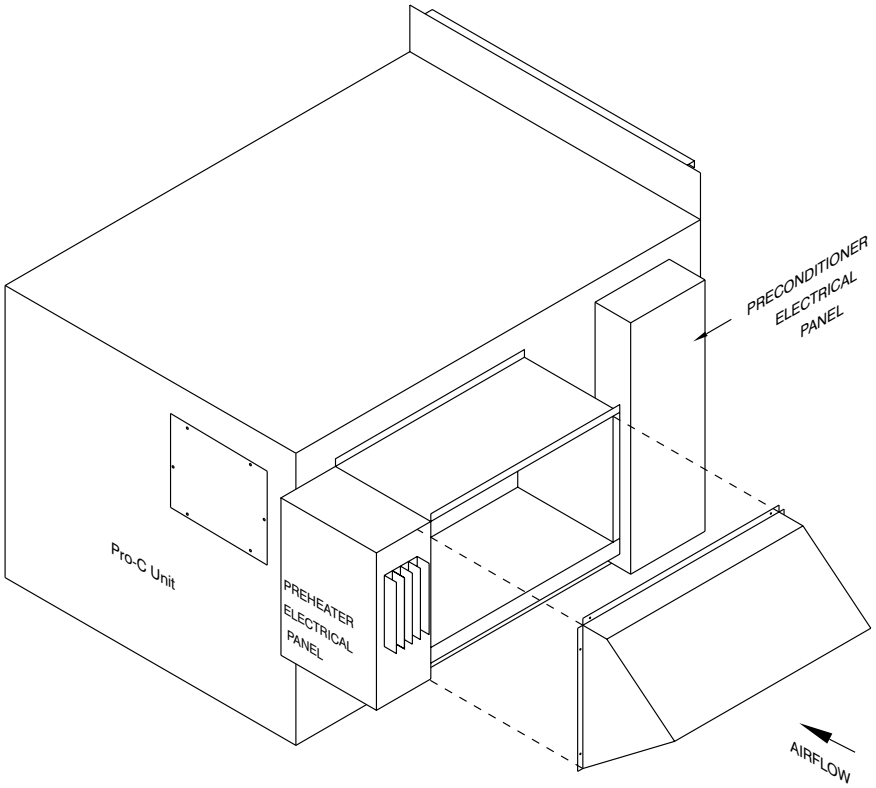


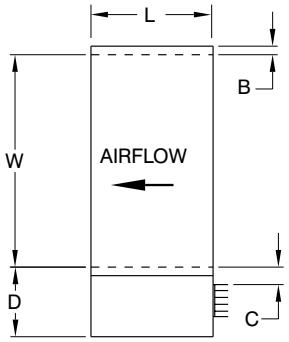
Model#	Net Wt. (lbs.)	Dimensions (inches)						
		A	B	C	D	E	F	G
PRO-C-1000	350	30.188	47.875	31.375	11.75	17.0	25.563	14.875
PRO-C-2400	475	38.813	54.750	40.375	13.0	20.0	27.0	21.375

Note: Dimensions F & G represent approximate unit center of gravity.

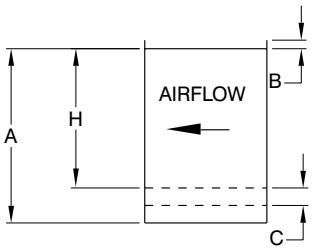
*Service clearance is equal to “C” dimensions.

Electric Preheat Layout





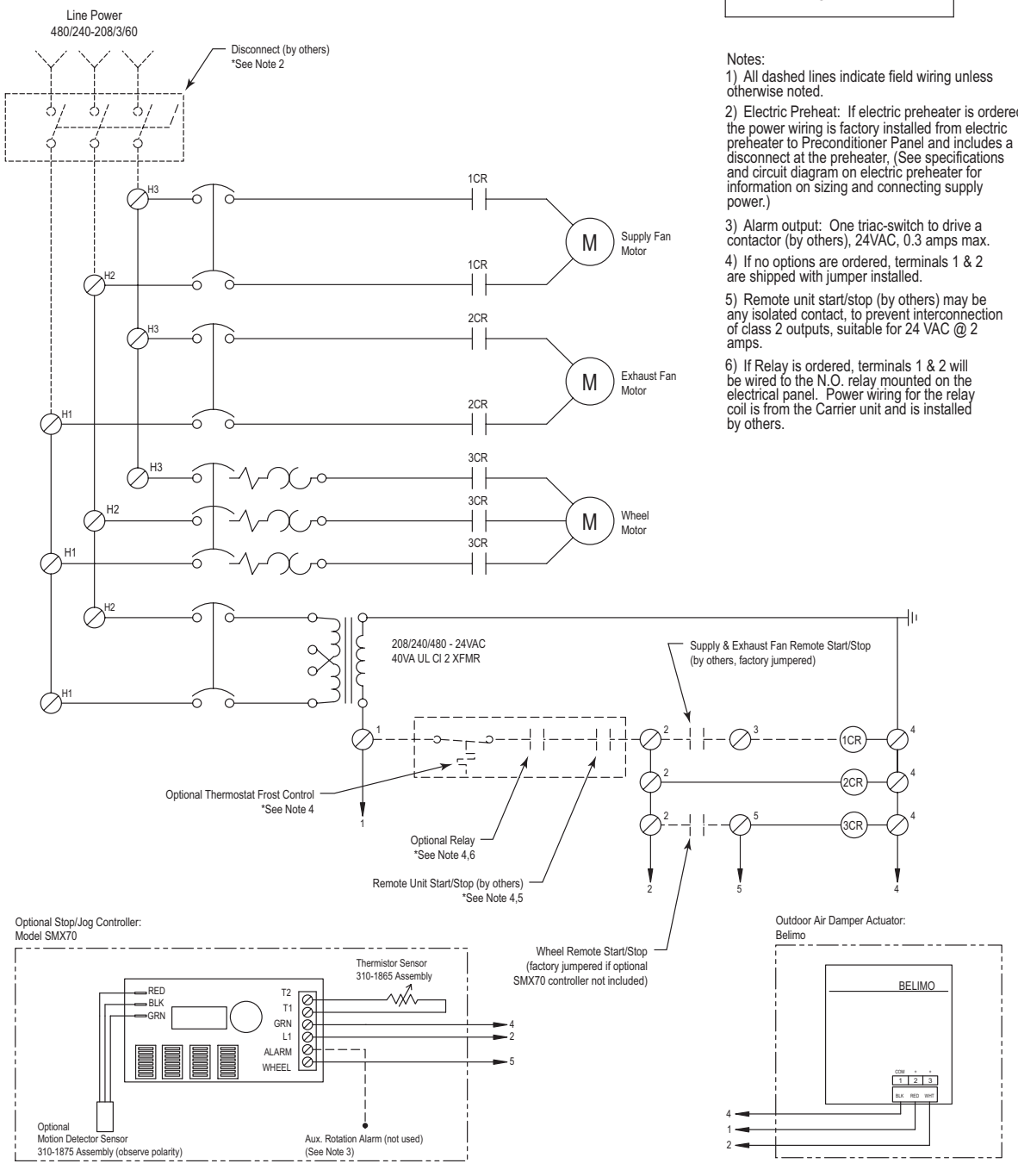
PLAN VIEW



SIDE VIEW

Model#	Dimensions (inches)						
	W	H	L	A	B	C	D
PRO-C-1000	24.37	16	14	20	1	2	8
PRO-C-2400	30.5	20.37	14	20	1	2	8

3Ø Circuit Diagram, PRO-C-1000



Notes:

1) All dashed lines indicate field wiring unless otherwise noted.

2) Electric Preheat: If electric preheater is ordered, the power wiring is factory installed from electric preheater to Preconditioner Panel and includes a disconnect at the preheater, (See specifications and circuit diagram on electric preheater for information on sizing and connecting supply power.)

3) Alarm output: One triac-switch to drive a contactor (by others), 24VAC, 0.3 amps max.

4) If no options are ordered, terminals 1 & 2 are shipped with jumper installed.

5) Remote unit start/stop (by others) may be any isolated contact, to prevent interconnection of class 2 outputs, suitable for 24 VAC @ 2 amps.

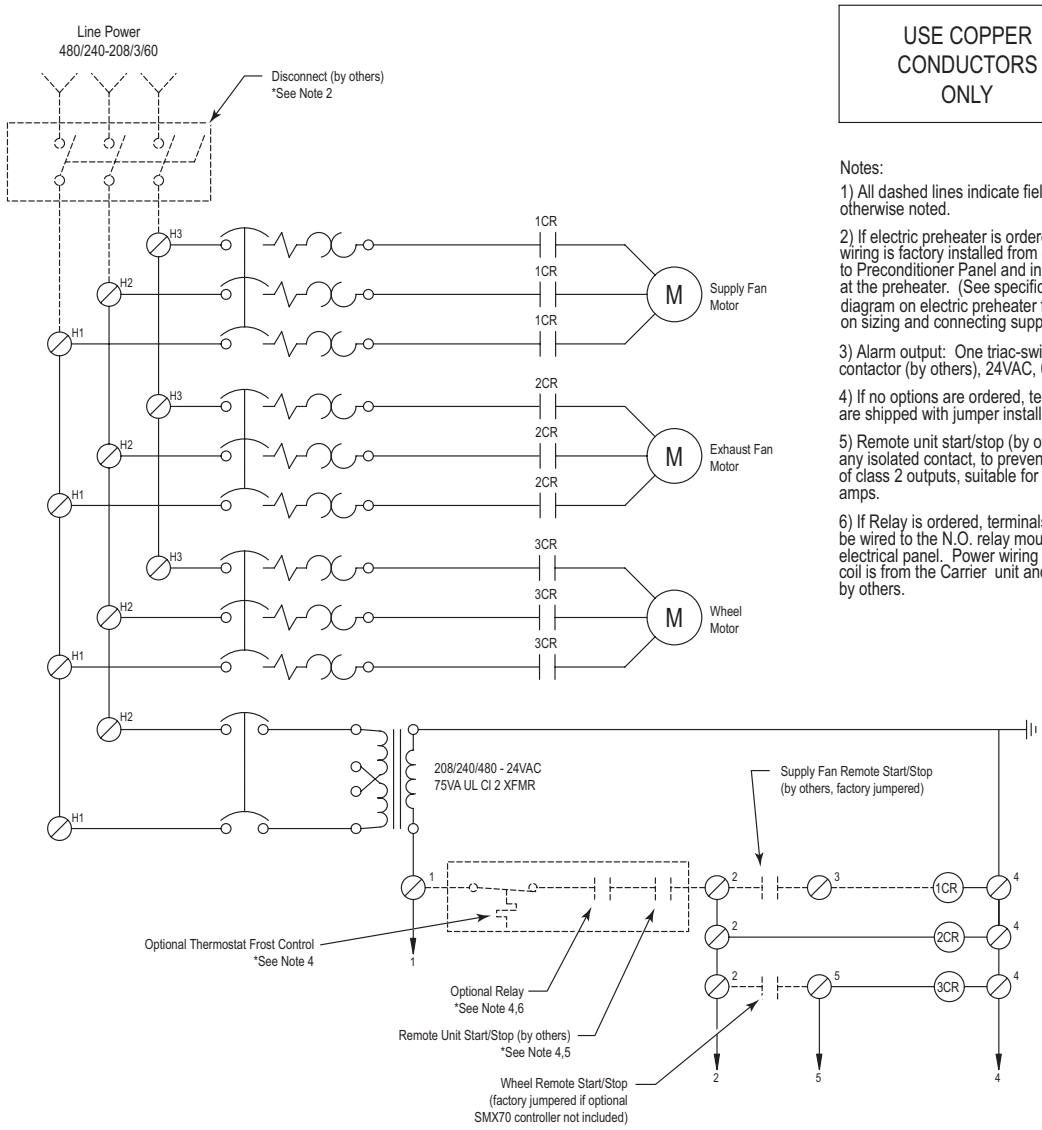
6) If Relay is ordered, terminals 1 & 2 will be wired to the N.O. relay mounted on the electrical panel. Power wiring for the relay coil is from the Carrier unit and is installed by others.

Tightening Torque
For
Slotted Screws

AWG Size	IN-LB
18-10	20
8	25
6-3	35

PRO-C Series

3Ø Circuit Diagram, PRO-C-2400



USE COPPER CONDUCTORS ONLY

Notes:

1) All dashed lines indicate field wiring unless otherwise noted.

2) If electric preheater is ordered, the power wiring is factory installed from electric preheater to Preconditioner Panel and includes a disconnect at the preheater. (See specifications and circuit diagram on electric preheater for information on sizing and connecting supply power.)

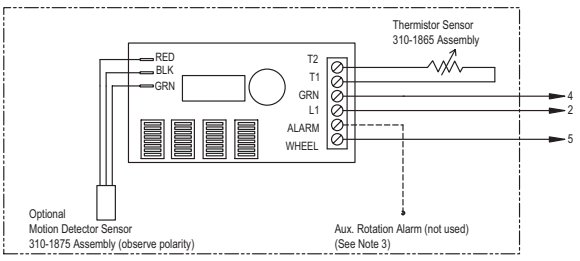
3) Alarm output: One triac-switch to drive a contactor (by others), 24VAC, 0.3 amps max.

4) If no options are ordered, terminals 1 & 2 are shipped with jumper installed.

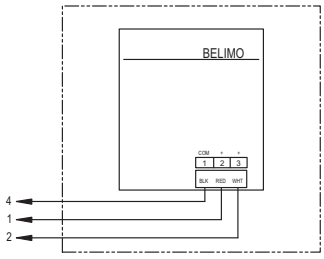
5) Remote unit start/stop (by others) may be any isolated contact, to prevent interconnection of class 2 outputs, suitable for 24 VAC @ 3.5 amps.

6) If Relay is ordered, terminals 1 & 2 will be wired to the N.O. relay mounted on the electrical panel. Power wiring for the relay coil is from the Carrier unit and is installed by others.

Optional Stop/Jog Controller:
Model SMX70

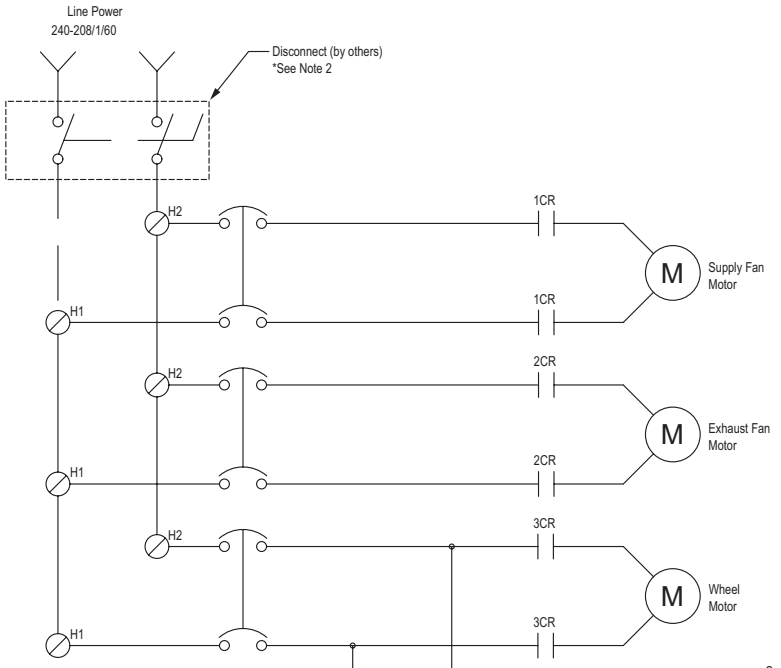


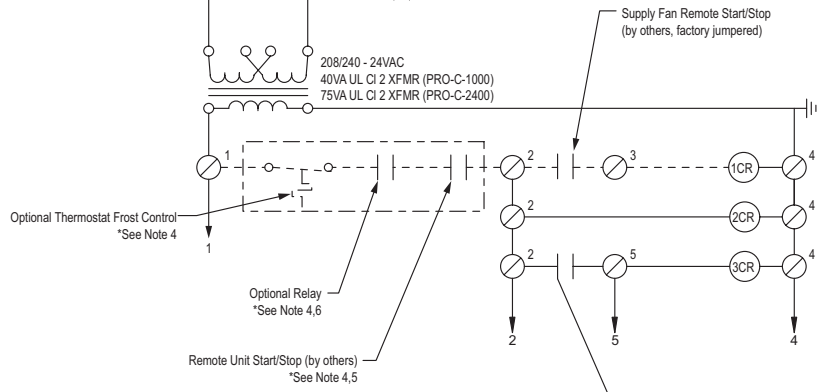
Outdoor Air Damper Actuator:
Belimo

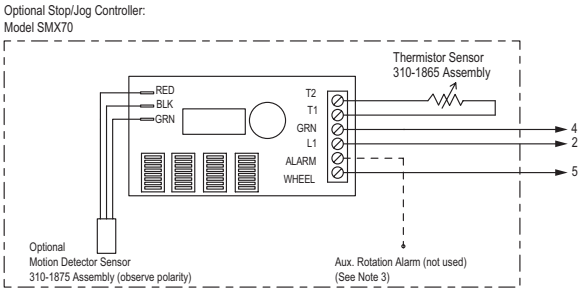


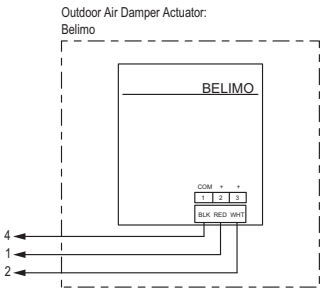
Tightening Torque For Slotted Screws	
AWG Size	IN-LB
18-10	20
8	25
6-3	35

1Ø Circuit Diagram, PRO-C-1000 & PRO-C-2400









USE COPPER CONDUCTORS ONLY

Notes:

1) All dashed lines indicate field wiring unless otherwise noted.

2) If electric preheater is ordered, the power wiring is factory installed from electric preheater to Preconditioner Panel and includes a disconnect at the preheater. (See specifications and circuit diagram on electric preheater for information on sizing and connecting supply power.)

3) Alarm output: One triac-switch to drive a contactor (by others), 24VAC, 0.3 amps max.

4) If no options are ordered, terminals 1 & 2 are shipped with jumper installed.

5) Remote unit start/stop (by others) may be any isolated contact, to prevent interconnection of class 2 outputs, suitable for 24 VAC @ 2 amps (PRO-C-1000) or 3.5 amps (PRO-C-2400).

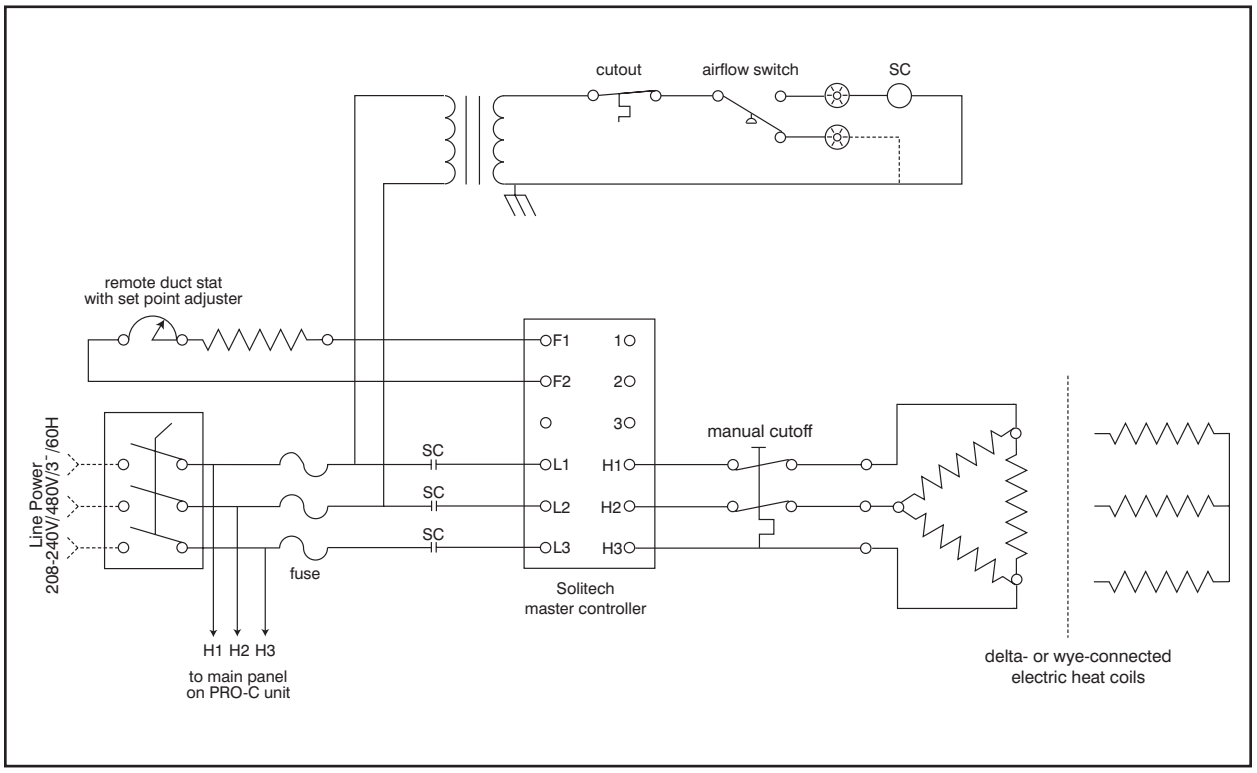
6) If Relay is ordered, terminals 1 & 2 will be wired to the N.O. relay mounted on the electrical panel. Power wiring for the relay coil is from the Carrier® unit and is installed by others.

Tightening Torque For Slotted Screws

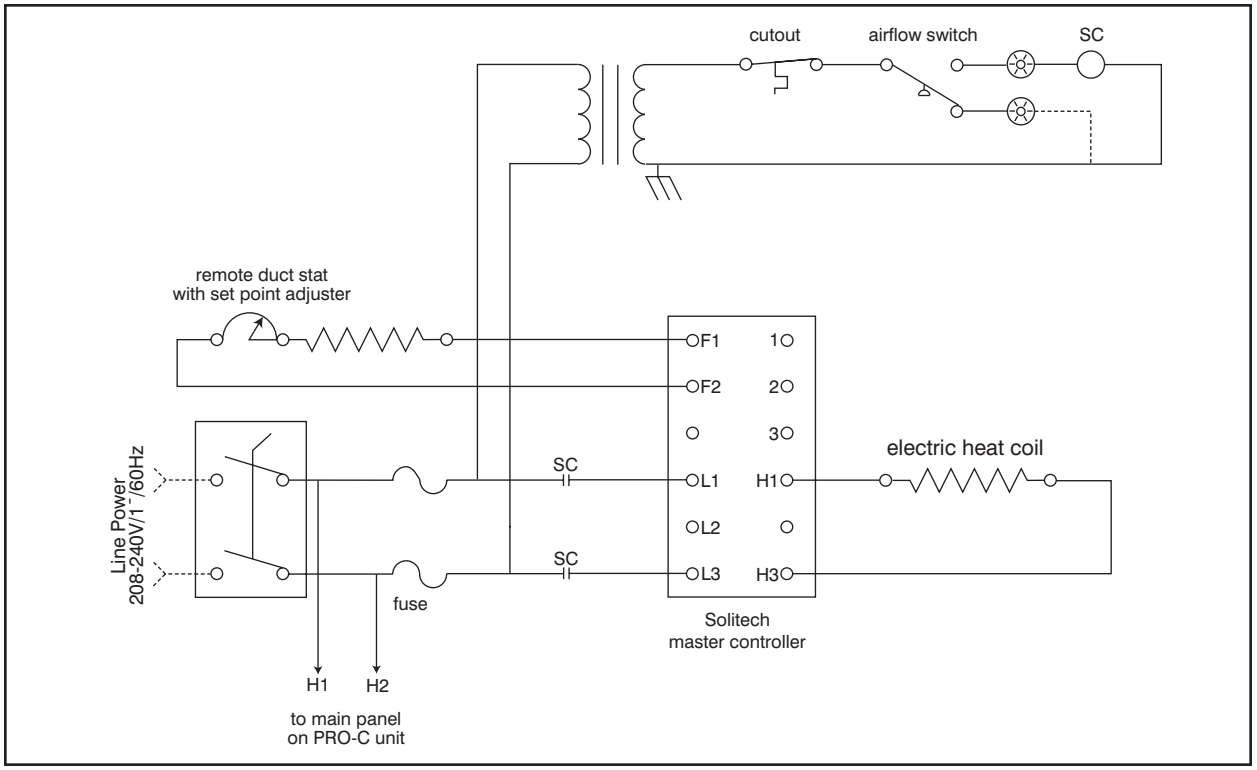
AWG Size	IN-LB
18-10	20
8	25
6-3	35

PRO-C Series

3Ø Electric Preheat Frost Control Circuit Diagram



1Ø Electric Preheat Frost Control Circuit Diagram



Select motors using the fan tables on page 6. For the unit and motors selected, Table 5 will have the corresponding full load amps (FLA) for each motor.

Equation 2a. Formula to determine minimum circuit ampacity (MCA) without pre-heater.

To determine minimum circuit ampacity (MCA):

1.25 * FLA largest fan motor (Table 5)
\+ FLA other fan motor (Table 5)
\+ FLA wheel drive/ accessories (Table 5)

= MCA

Equation 2b. Formula to determine minimum circuit ampacity (MCA) with preheater.

To determine minimum circuit ampacity (MCA):

FLA exhaust fan motor (Table 5)
\+ FLA supply fan motor (Table 5)
\+ FLA wheel drive/ accessories (Table 5)
\+ FLA optional preheater (Table 6)
* 1.25

= MCA

Equation 3. Formula to determine maximum overcurrent protection (MOP).

To determine maximum overcurrent protection (MOP):

For the PRO-C-1000 without preheater: MOP=15

For the PRO-C-2400 with preheater:

2.25 * FLA largest fan motor (Table 5)
\+ FLA other fan motor (Table 5)
\+ FLA wheel drive/ accessories (Table 5)
\+ FLA optional preheater (Table 6)

= MOP

Using the total above, select the next smaller sized time delay fuse (LOW-PEAK™ , FUSETRON or equivalent) or HACR-type circuit breaker, minimum of 15 amps. If the fuses/breakers do not hold, consult the National Electric Code for suitability of larger fuses/breakers.

Full Load Power Draw

Unit	Full Load Power Draw (Amps)					
	Motor Size (hp)	208V/1Ø	240V/1Ø	208V/3Ø	240V/3Ø	480V/3Ø
PRO-C-1000	3/4	7.6	6.9	7.6	6.9	3.5
	Wheel drive/ accessories	1.1	1.1	0	0	0
PRO-C-2400	1/3	4.0	3.6	1.7	1.6	0.8
	3/4	7.6	6.9	3.5	3.2	1.6
	1-1/2	11.0	10.0	6.6	6.0	3.0
	2	13.2	12.0	7.5	6.8	3.4
	3	-	-	10.6	9.6	4.8
	Wheel drive/ accessories	1.6	1.6	1.6	1.6	1.6

Table 5. Electric Unit Data, Full Load Power Draw.

Electrical Preheat Data

An electric preheat coil is an available option for all PRO-C units to limit the risk of frost formation for projects that involve high indoor humidity and/or extreme winter design conditions.

Applications involving space conditions that will exceed 30 percent relative humidity when the outdoor air temperature is below 0°F, should be evaluated to see if preheating is necessary. In such cases it is best to contact your local Carrier-ERV Systems representative for assistance.

Most applications that do not involve space humidification will function as desired without preheating. Even in extremely cold climates, 10 to 15 degrees of preheat, which is only operated on extreme days, will usually prove adequate to avoid frost formation.

Table 6 should be used to select the appropriate size electric pre-heater for a given application. Often it is best to make this selection in conjunction with your local Carrier-ERV Systems representative to assure proper sizing.

Model	Nominal Pre-heater Size (kW)	Temperature Rise @ Full kW (°F)	Actual Preheater Size (kW) / Full Load Power Draw (Amps)				
			208V/1Ø	240V/1Ø	208/V3Ø	240V/3Ø	480V/3Ø
PRO-C-1000	3.0	9-19	3.40 / 16.3	3.50 / 14.6	3.00 / 8.3	3.00 / 7.2	3.50 / 4.2
PRO-C-2400	7.5	10-29	7.65 / 36.8	7.5 / 31.3	7.65 / 21.2	7.5 / 18.0	7.5 / 9.0

Table 6. Electric Preheat Data.

Order Summary Sheet

ERV SYSTEMS

PRO-C-Series Energy Recovery Module For Carrier® Weathermaker™ & Weathermaster™ Units		
JOB NAME:_____		UNIT ID: _____
PRO-C MODEL	❑ PRO-C-1000	❑ PRO-C-2400
CARRIER MODEL NUMBER		
UNIT VOLTAGE	❑ 208V/1PH ❑ 240V/1PH ❑ 208V/3PH ❑ 240V/3PH ❑ 480V/3PH	❑ 208V/1PH ❑ 240V/1PH ❑ 208V/3PH ❑ 240V/3PH ❑ 480V/3PH
SUPPLY STATIC (in. wg.)		
OUTSIDE AIR FLOW RATE (cfm)		
RETURN STATIC (in. wg.)		
EXHAUST AIR FLOW RATE (cfm)		
ELECTRIC PREHEAT (kW)	❑ NO ❑ 3	❑ NO ❑ 7.5
DISCONNECT (Non-fused)	❑ NO ❑ YES	❑ NO ❑ YES
ECONOMIZER Stop/Jog with Rotation Sensor & Low Temp Frost Protection (SMX-70)	❑ NO ❑ YES	❑ NO ❑ YES
START/STOP RELAY (24V AC)	❑ NO ❑ YES	❑ NO ❑ YES
THERMOSTAT FROST PROTECTION	❑ NO ❑ YES	❑ NO ❑ YES
SEGREGATED EXHAUST ADAPTER	❑ NO ❑ YES	❑ NO ❑ YES
PEDESTAL SUPPORT	❑ NO ❑ YES	❑ NO ❑ YES
Please Note: This order summary MUST be completed in full by the Sales Engineer.		

Instructions: _____

Sample Specifications

CASING

Standard panels shall be 20 gauge galvanized steel, lined with 1/2 inch thick neoprene insulation where required. The housing shall be supported by a formed structural base that forms a pan to ensure weather tight construction. Lifting holes shall be provided at the unit base. Units shall have a weatherproof sheet metal roof. The outdoor air intake opening shall be protected by a galvanized steel sheet metal weather hood and include an automatic shutoff damper with electric operator. The exhaust air discharge shall be covered with a gravity backdraft damper and weather hood. The exterior of the unit shall be coated with an epoxy primer and a polyurethane enamel painting system for added protection. Painting system shall be rated to meet a 1500 hour salt spray test.

Access

Access to components shall be provided through a large, tightly sealed and easily removable access panel. Access panels shall be constructed of the same materials as the unit casing and use standard hardware. The wheel cassette shall be easily removable from the unit. The roof of the unit shall also be removable for access.

Unit Configuration

The supply air inlet and exhaust air outlet must be oriented at opposite sides of the Energy Recovery System to maximize the distance between the two airstreams in order to minimize the risk of short circuiting exhaust air into the supply air intake.

FANS

Fans shall have forward curve type wheels. The blades shall be designed for maximum efficiency and quiet operation. Impellers shall be statically and dynamically balanced.

Fans shall be driven by direct drive motors located at the fan inlet or by motors using belts and sheaves. Motors shall be standard NEMA frame with open drip-proof enclosures. V-belt drives shall be designed for a minimum 1.2 service factor.

TOTAL ENERGY WHEEL

The rotor media shall be made of aluminum which is coated to prohibit corrosion. The rotor media shall be coated with a non-migrating adsorbent to transfer water vapor and to prohibit corrosion. Equal sensible and latent recovery efficiencies shall be clearly documented through a certification program conducted in accordance with ASHRAE 84-91 and ARI 1060 standards. The media shall be cleanable with low temperature steam, hot water or light detergent, without degrading the latent recovery. Dry particles up to 600 microns shall freely pass through the media. Wheel media shall be independently tested and shown to have a flame spread of less than 25 and a smoke generation rating of less than 50 when tested in accordance with ASTM-E-87.

Rotor Cassette

The rotor cassette shall be a sheet metal framework which limits the deflection of the rotor due to air pressure. The cassette shall be made of galvanized steel to prevent corrosion. The rotor cassette shall be easily removable from the Energy Recovery Unit to facilitate rigging (if necessary) and ease of service. The wheel cassette design shall use pillow block bearings for long life. A non-adjustable purge sector shall be included in the cassette.

FILTERS

The filters shall be 1 inch thick permanent aluminum washable type mounted in the outside air hood and in the return air plenum. The filters shall be listed by Underwriters' Laboratories as Class 2.

Optional Rotation Detector

Unit shall be equipped with a rotation sensor and controller such that should the energy recovery wheel not rotate during a signaled run period, the controller shall send a 24 volt AC signal suitable for operating a relay to be used as an alarm contact. The controller shall not initiate an alarm during a stop/jog function.

Optional Stop/Jog Economizer

Unit shall be equipped with an outdoor air temperature sensor and controller such that the energy recovery wheel can be stopped during moderate temperature periods. The controller shall perform a stop/jog function for the wheel long enough to promote the self cleaning features of the wheel but not long enough to induce energy recovery.

Optional Wheel Stop/Jog Frost Protection

Unit shall be equipped with an outdoor air temperature sensor and controller such that the energy recovery wheel can be operated in stop/jog mode during very low outdoor air temperature periods to prevent freezing of the wheel while still delivering outdoor air through the unit.

Optional Electric Preheat Coil

Coil shall be of the resistance coil type with elements enclosed in a steel sheath with fins and painted with a baked-on aluminum paint for long life in a 100% fresh air stream. Coil shall include thermal cutout protection with automatic primary protection and a secondary manual reset linear thermal cutout. Coil shall have magnetic safety and

backup contactors, main disconnect, fusing, control circuit transformer, air flow interlock switch and SCR controller. Coil shall be UL listed and constructed in accordance with NEC requirements. A temperature controller located in the outdoor air section of the unit shall supply the signal to the SCR controller.

Optional Freeze Protection Thermostat

Unit shall be equipped with an outdoor air temperature thermostat such that the energy recovery ventilator can be stopped during very low temperature periods. This thermostat shall stop the both the fans and the energy recovery wheel until the outdoor air temperature rises above the setpoint, then the unit will restart automatically.

ELECTRICAL

Units shall require a single 60 cycle power connection. See schedule for voltage and phase requirements. The electrical panel shall consist of individual motor contactors, short circuit and overload protection and control power transformer. The NEMA 3R electrical panel shall be mounted on the unit exterior for ease of access. Unit shall be ETL listed and labeled.

SOLE AND EXCLUSIVE WARRANTY

ERV Systems warrants to Buyer that for a period of eighteen months from the date of shipment by ERV Systems the goods to be delivered to Buyer will in all material respects be free from defects in material and workmanship when used in a proper and normal manner. Should any failure to conform to the above appear within eighteen months after the date of shipment by ERV Systems (the "Limited Warranty Period"), ERV Systems agrees upon prompt notification thereof during the Limited Warranty Period and confirmation to ERV Systems' satisfaction that the goods have been stored, installed, operated and maintained properly and in accordance with standard industry practice, to correct the non-conformity at ERV Systems' option either by repairing any defective part or parts or by making available at ERV Systems' plant a repaired or replacement part.

Notes

Notes

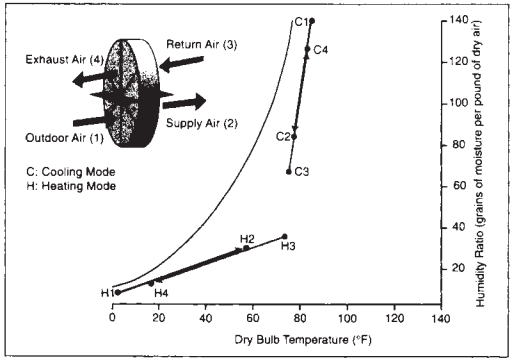
Notes

PSYCHROMETRIC CHART

SEA LEVEL

ERV SYSTEMS

Barometric Pressure: 29.921 inches of mercury



Psychrometrics for a typical total energy wheel application. Note how the outdoor air is cooled and dehumidified during summer and heated and humidified during winter.

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